Heuristics and biases in cardiovascular disease prevention

How can we improve communication about risk, benefits and harms?

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Title: Heuristics and biases in cardiovascular disease prevention: How can we improve communication about risk, benefits and harms?

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ABSTRACT

Objective: Cardiovascular disease (CVD) prevention guidelines recommend medication based on the probability of a heart attack/stroke in the next 5-10 years. However, heuristics and biases make risk communication challenging for doctors. This study explored how patients interpret personalised CVD risk results presented in varying formats and timeframes.

Methods: GPs recruited 25 patients with CVD risk factors and varying medication history. Participants were asked to 'think aloud' while using two CVD risk calculators that present probabilistic risk in different ways, within a semi-structured interview. Transcribed audio-recordings were coded using Framework Analysis.

Results: Key themes were: 1) numbers lack meaning without a reference point; 2) risk results need to be both credible and novel; 3) selective attention to intervention effects. Risk categories (low/moderate/high) provided meaningful context, but short-term risk results were not credible if they didn't match expectations. Colour-coded icon arrays showing the effect of age and interventions were seen as novel and motivating. Those on medication focused on benefits, while others focused on harms.

Conclusion: CVD risk formats need to be tailored to patient expectations and experiences in order to counteract heuristics and biases.

Practice implications: Doctors need access to multiple CVD risk formats to communicate effectively about CVD prevention.

1. INTRODUCTION

1.1 The role of risk in CVD prevention

For cardiovascular disease (CVD) prevention, probabilistic risk is central to clinical guidelines that determine whether medication should be prescribed to a patient [1]. CVD risk calculators based on large cohort studies take modifiable (e.g. blood pressure, cholesterol, smoking) and non-modifiable (e.g. age, sex, diabetes) risk factors into account, to identify patients at highest risk of a heart attack or stroke [2, 3]. This is a better way to recommend medication than treating blood pressure or cholesterol as isolated risk factors, because it targets patients at highest risk who are most likely to benefit from taking medication [4]. Different countries use varying 5-10 year risk models with different treatment thresholds [1]. Ten year models include a US calculation with race as a risk factor and a 7.5% threshold for medication; a UK calculation that includes socio-economic area and a 10% threshold; and a European model that differentiates between low and high risk countries with a 10% threshold [5-7]. Five year models include Framingham calculations used in Australia and New Zealand with a 15% medication threshold for general populations and lower thresholds for high risk ethnicities [8-10].

1.2 The importance of communication in CVD risk assessment

Qualitative research has found the meaning of CVD risk can be confused by uncertainty about the role of risk factors in a particular model, and conflicting results when different models are used for the same patient [11, 12]. Doctors and patients may be unaware of how model assumptions affect the risk result: the specific CVD outcomes (e.g. mortality versus heart attack), timeframes (e.g. 5 versus 10-year risk) and medication thresholds (e.g. prescribe at 10% versus 15% risk) all have a big impact on the final result. Doctors report

communication as a key barrier to using risk calculators, as the relationship between CVD risk and prescribed medication can be a challenging concept to convey [13, 14]. 'High risk' is easier to explain in relation to blood pressure and cholesterol results [13, 15], but it is less obvious that the strongest drivers of CVD risk are non-modifiable: age and sex [1]. Doctor-patient communication is especially challenging in two situations: 1) low risk patients who may progress to high risk unless they make lifestyle changes (e.g. a young overweight smoker with mildly elevated blood pressure), and 2) low risk patients who would be treated for isolated risk factors under previous guidelines (e.g. high cholesterol but no other risk factors), but would actually be classified as low risk if a probabilistic risk calculation was undertaken [13, 14, 16]. Doctors worry that probabilistic risk estimates may undermine lifestyle change messages if the number is perceived as 'low', or equally it may cause anxiety if perceived to be 'high' [13, 14]. Other challenges include explaining risk to patients with low health literacy [17]. Many patients remain unaware of their CVD risk, its meaning and the rationale for medication or lifestyle recommendations [14].

1.3 What we already know about CVD risk communication

We know from the broader risk communication literature that absolute probabilities and natural frequencies are better understood than relative risk formats, and that visual aids can be helpful especially when combined with verbal descriptions [18]. A review of CVD risk format studies recommended probabilities, frequencies, graphs and shorter time frames, but most of the included studies were based on hypothetical risk over 10 years or longer [19]. Cognitive psychology research shows that decision making based on probabilistic risk is also influenced by many heuristics and biases, including three key phenomena that may influence CVD risk perception: availability, representativeness, and anchoring and

adjustment [20, 21]. For availability, people will judge risk based on how easily they can access the mental image of a CVD event. For representativeness, they will judge how likely a risk profile matches their perception of a typical "high risk" person. For anchoring and adjustment, people will pay most attention to the salient risk number with insufficient adjustment for contextual information such as the timeframe for the risk (e.g. 20% risk over 10 years seems higher than 10% risk over 5 years). Since previous research has focused on hypothetical 10 year risk, we sought to address a gap in the literature by exploring patients' personalised risk in both 5 and 10 year timeframes, to better reflect current CVD prevention guidelines and clinical practice.

1.4 Aim

The aim of this study was to explore how patients make sense of and interpret CVD risk results presented in a variety of numerical, verbal and graphical formats, including both shorter (5 year) and longer (10 year) timeframes.

2. METHODS

2.1 Recruitment

General Practitioners (GPs) in New South Wales, Australia invited patients aged 35-74 years with CVD risk factors. From returned expression of interest forms, purposive sampling was used to recruit 25 participants. In line with the qualitative approach, we aimed to recruit a diverse rather than representative sample [22], by selecting patients with varying CVD risk factors (e.g. age, gender), medication use and experience of CVD events, ranging from low to high risk [3]. Analyses of 25 interviews suggested theoretical saturation with adequate

explanation of meaningful formats for probabilistic risk, so no further recruitment was conducted [23]. Table 1 shows participants were most likely to be female (60%), aged 65-74 (13%), were currently taking at least one CVD-related medication (56%), and their pre-medication risk was estimated to be low (<10% over 5 years) under current Australian guidelines (84%). However, there was a wide range in each of these factors. The average risk result was 5.8% for 5-year risk (range 0-16%), and 15.1% for 10-year risk (range 0-37%). Ethics approval was obtained through the Sydney Local Health District.

Table 1: Participant characteristics

Participant characteristics	**Number (%)**
Sex	
Female	15 (60)
Male	10 (40)
Age	
35-44	2 (8)
45-54	1 (4)
55-64	9 (36)
65-74	13 (52)
5-year probabilistic risk result (estimated pre-medication risk)	
Low (<10%)	21 (84)
Moderate (10-15%)	3 (12)
High (>15%)	1 (8)
CVD prevention medication	
Never prescribed	8 (32)
Ceased taking medication	3 (12)
Cholesterol medication only	5 (20)
Blood pressure medication only	2 (8)
Diabetes medication only	2 (8)
Cholesterol and BP medication	5 (20)
Established CVD	
No	21 (84)
Yes	4 (16)

2.2 Materials Two CVD risk calculators were used to explore a wide range of personalised risk formats (see Table 2 for key features, and Figures 1-2 for examples). Interface 1 was developed by the authors to explore new 5-year risk formats that were not available in existing online calculators, including an analogy (i.e. imagining 100 people sitting in a cinema) and a bar graph comparing 5-year risk to target and average risk. This was embedded in the existing Healthy.me app, a personal health management system. The authors added the 5-year Australian risk calculator to the app for this study, with changes made after the first 10 interviews to adapt useful features from Interface 2 into a 5-year risk format. Interface 2 was a publicly available website that allows comparison of different CVD risk models and the estimated effect of medicine/lifestyle interventions on CVD risk using icon arrays. This calculator provides more detailed information in "enhanced results", but we changed this to "basic results" after the first 10 interviews to simplify the content.

Table 2: Main differences between the two probabilistic risk calculators

Variable	Interface 1: Healthy.me app	Interface 2: www.cvdcalculator.org
Timeframe	5-year risk based on Framingham Risk Equation	10-year risk (with adjustable timeframe for 1-9 years) based on Framingham Risk Equation
Include % risk	Yes – % and risk category level (mild, moderate, high)	Yes - %, no risk category label
Graphical display	Bar graph showing risk % compared to target risk for age and gender	Icon array based on 100 faces, with red frowning faces for risk and green smiling faces for intervention benefit
Risk factors asked about	Age, gender, smoking, diabetes, systolic blood pressure, total/HDL cholesterol	Age, gender, smoking, diabetes, systolic blood pressure, total/HDL cholesterol + family history adjustment to risk result
Effect of lifestyle & medication interventions on risk (see Figures 1-2 for examples)	**Stage 1 (n=10 interviews):** Effect of interventions described in management guidelines but not linked to individual risk result **Stage 2 (n=15 interviews):** Added buttons to show effect of cholesterol medication and physical activity on risk result (both estimated to reduced risk by 25%, based on website references)	**Enhanced results (Stage 1 only, n=10 interviews):** Additional medications ad supplements shown with little explanation of medical terms/abbreviations, and risk/benefit broken down into baseline risk (from age/gender) versus modifiable risk factors (from smoking/cholesterol/blood pressure) **Basic results (Stage 1 and 2, n=25 interviews):** Click buttons to show relative benefit of lifestyle (e.g. physical activity, Mediterranean diet) and medication (e.g. blood pressure/cholesterol lowering medication and aspirin) options

2.3 Process

The participant experience of the two interfaces was very similar, using a tablet to explore the risk calculator component (see Figures 1-2 for example results). A protocol including think aloud instructions and semi-structured interview methods was developed (see

Appendix 1), based on research showing that a concurrent think aloud protocol elicits more information about the user experience of written information, but additional insights can be gained retrospectively [24]. The interviewers (CB, SM) were trained in public health qualitative methods, and had previously used a similar protocol for a different risk calculator study [11]. Participants were asked to think aloud as they used each calculator, with minimal input from the interviewer. Participants were told that pre-medication risk factors should be used, and were provided with sex/age-based averages if they could not recall their blood pressure or cholesterol. No interpretation of the results was provided until the end of the interview. In order to practice thinking aloud, participants described what they were doing while completing a simple 'spot the difference' task before using the risk calculators. A 'keep talking' sign was shown if the participant was silent for more than 10 seconds. The entire session was audio-recorded and transcribed verbatim. Two changes were made after Stage 1 preliminary findings (n=10 interviews), and were retained for all Stage 2 interviews (n=15). Firstly, the Healthy.me risk calculator was altered to incorporate features of the website to investigate alternative ways of displaying 5-year intervention effects. Secondly, the "enhanced" version of the website was not explicitly shown as the level of detail was confusing to participants (see Table 2 for further explanation).

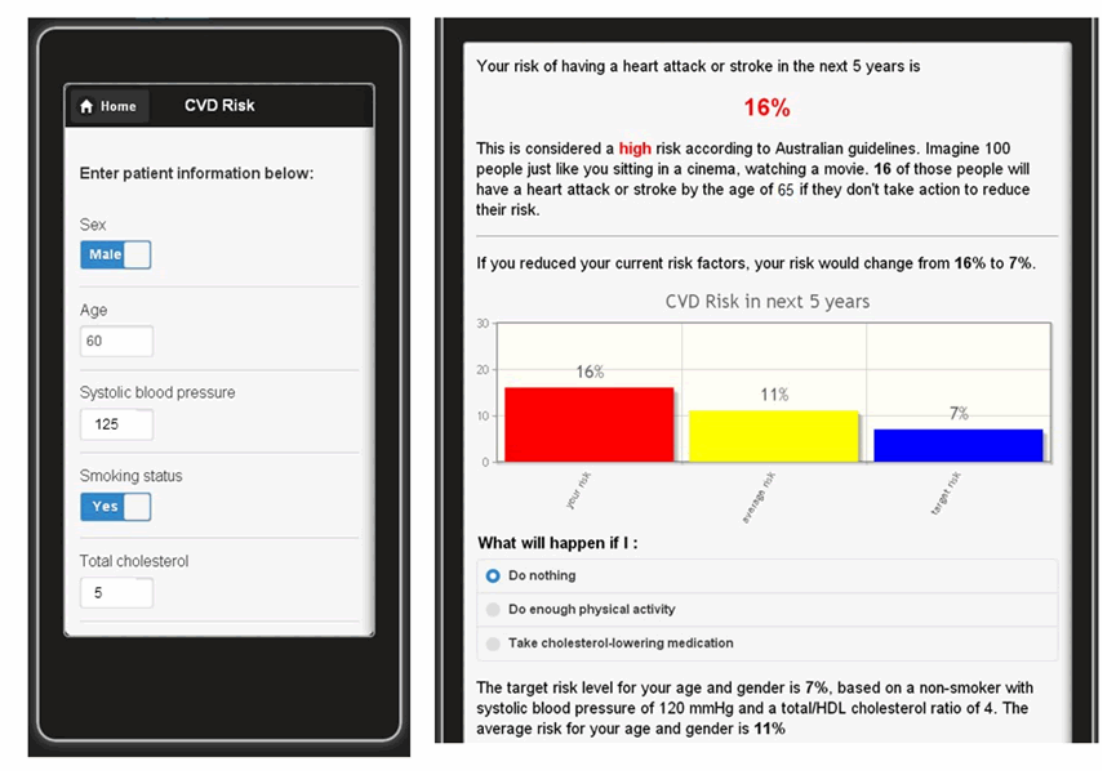


Figure 1: Healthy.me App risk calculator (risk factor questions & risk result)

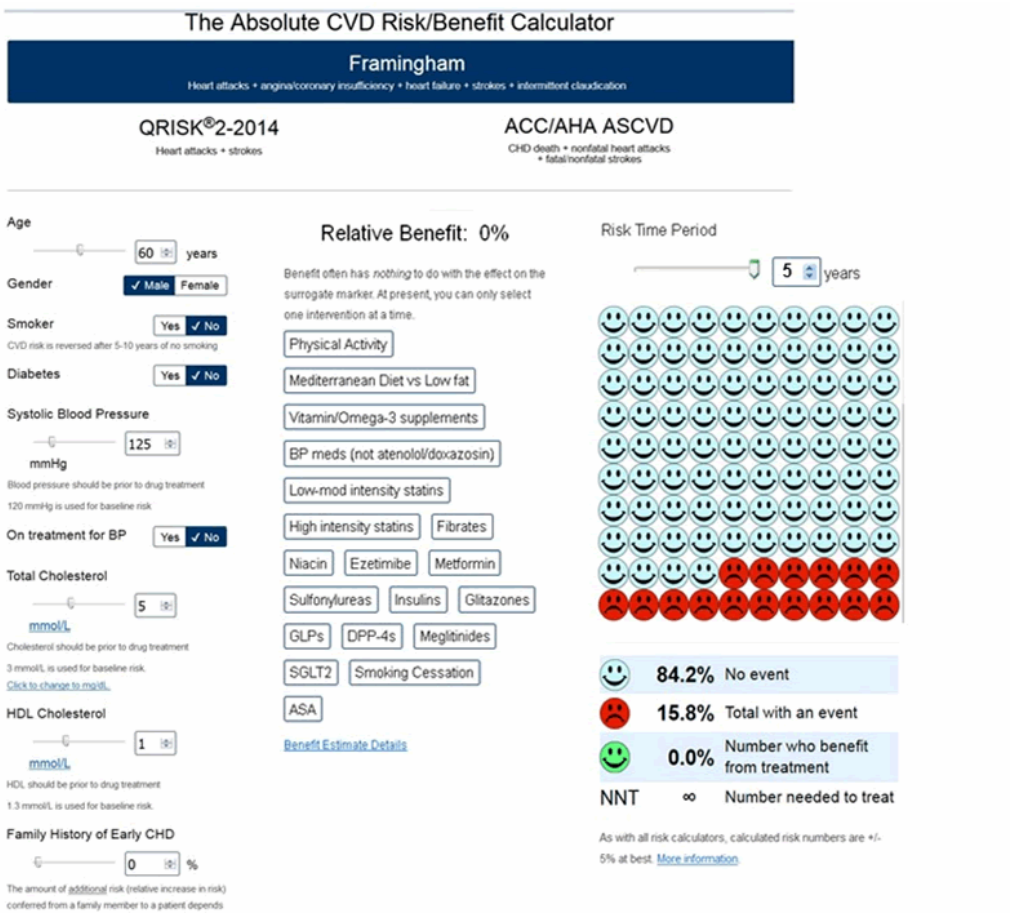


Figure 2: www.cvdcalculator.org risk calculator (risk factor questions & risk result)

2.4 Analysis

A Framework Analysis method was used to analyse the interview transcripts, which involves five steps [25]. 1) Familiarisation with the data: CB read through all 25 transcripts, recorded the calculator input/output for each participant from transcripts and field notes, and discussed this and transcript excerpts with all authors. 2) Creating a thematic framework: CB, SM and AL read a sample of Stage 1 transcripts and developed the initial framework. 3) Indexing: CB and SM coded the remaining Stage 1 and 2 transcripts according to the framework, with new themes and revisions to the framework discussed (see Appendix 2). 4) Charting: CB and SM summarised themes and supporting quotes from each transcript in the framework (a matrix with participants as rows and themes as columns), with discussion to resolve any disagreement. 5) Mapping and interpretation: CB examined the framework within and across themes and participants to identify overarching themes and relationships, SM read identified supporting/dissenting quotes for each theme to check the findings, and the results were discussed with all authors. Rigour was addressed by: repeated coding of transcripts by different team members to ensure a comprehensive themes list and framework was achieved; an iterative process of constant comparison between the existing framework and new data; detailed documentation of the analysis process; and discussion of emerging and final themes with all authors [26].

3. RESULTS

Three key themes were found across participants on and off medication.

3.1 Theme 1: Numbers lack meaning without a reference point

Participants could not tell whether a percentage result was good or bad unless they linked it to an appropriate reference point, most commonly the risk category label (e.g. low risk or high risk). The timeframe and comparison to average or ideal risk was rarely mentioned by participants in the think aloud process, until prompted in the interview. Those who did not notice a reference point at all found the result difficult to interpret.

> *"I've got no idea…no idea what it means." (ID54, F, 59 years, med - diabetes)*

> *"Well if it's 6.6%, my question is what's the percent out of? Is it a stat like across Australia for my age group that I'm looking at?" (ID69, F, 66 years, no med)*

Risk category labels were useful for providing context for the risk estimate, but the perceived threshold for 'high risk' was very variable and generally much higher than those provided in Australian guidelines (15% over 5 years).

> *"Well 13% out of a hundred's pretty low. Anything under 25 is pretty low" (ID11, M, 59 years, no med)*

> *"You know, 8%, 6% – it's okay. It's again a mathematical – it's a number, but doesn't have really such a big impact on one's life. You're low risk, medium, high. It's more when you're high that you need to do something." (ID25, M, 62 years, no med)*

Little attention was paid to the timeframe for the risk result in the think aloud process. This meant that the 10-year website appeared to give a result that was approximately double the result in the 5-year app. When asked about this difference, some participants felt that the 10-year risk result was a better indication of 'high risk' or the need to take action. However, the shorter 5-year timeframe were described as easier to plan for, and more relevant for older patients with shorter lifespans.

> *"So I guess being able to increase the timeframe to ten then makes it clear that it's worth taking a variety of actions." (ID28, F, 72 years, med - BP)*

> *"Five years is good. Ten gives you a prospect, but so many things change in ten years." (ID25, M, 62 years, no med)*

> *"I guess it depends on your age, doesn't it? If you're an 80-year-old doing this, then 10 years is maybe a bit far away. For me as a 62-year-old 10 years is fine" (ID46, M, 62 years, no med)*

3.2 Theme 2: Risk results need to be both credible and novel

To achieve credibility, participants preferred more risk factors to be taken into account in the risk assessment. Mentioning family history and lifestyle interventions alongside the results in the website gave the impression that it was a more comprehensive assessment. The app mentioned these extra risk factors on a separate page from the risk result, which reduced its credibility.

"Gee it's (app) very basic. Surely it needs more factors feeding in what we just did…We put in age, gender, higher blood pressure reading and cholesterol reading…no questions about exercise, no questions about lifestyle stress." (ID13, M, 62 years, med - diabetes)

When prompted to reflect on their risk results in the interview, participants described their expectations about their risk level. The pre-medication risk result was generally perceived as too low considering a doctor had recommended medication. Some low risk participants not on medication also felt their risk should be higher, and even chose to view information from a higher risk category than the result had suggested (e.g. picking moderate risk when the result said they were low risk).

"I would have thought to myself if it's only 8% why bother. Is what I would have thought to be honest with you. Um, if somebody had told me it was 50% or something like that I would have thought, my god, what have I got to do." (ID81, M, 69 years, med – chol and BP, est. CVD)

"It means pretty low, I actually think, I think I'm a lot higher than that. If you were to put into, I you were to put into more detail about my life I think I would come up as high as opposed to low." (ID21, F, 43, no med)

However, some risk formats could be surprising without reducing credibility. Participants showed interest in the concept of future risk - that their CVD risk would increase over time, and that intervention now was to prevent CVD outcomes in future. This concept arose

either through calculating their future risk at an older age, or comparing the 5-year and 10-year results.

> *"Oh, gosh…But that's, you know, that's ok, so in 12 years' time. Because age increases your risk….Yeah, so that looks much more serious." (ID7, F, 48 years, ceased BP med)*

> *"Because I hadn't actually thought about that, that the cholesterol isn't for right now, it is stopping it from causing a problem further down the track." (ID53, F, 57 years, med - chol)*

The response to future risk appeared to be enhanced by using a longer timeframe (10-year risk) with a colour-coded icon array, because participants focused on the higher number of red faces. This was described as more impactful than the bar graph comparing to target/average risk, although some felt the smiley faces were childish or trivialised the seriousness of CVD.

> *"I prefer the smiley faces because they're more impactful…. This [bar] graph I can ignore quite easily. But the other graph whether it's because of the content in it, I don't know but it makes you appreciate the - what 13% means and what 26% means versus a lesser number." (ID22, M, 68 years, med – chol and BP, est. CVD)*

"So I think if I had a lot of frowning faces I would be like wow, I really have to change something. It's kind of in your face because it's red and it's kind of like that danger symbol from the colour." (ID4, F, 39 years, no med)

“Cos we’ve got so many smiley faces there…I think it gives you very much…the idea that it’s not very bad. I think that it really, what this should be is giving you a much serious, much more serious message to say look, this is a problem.” (ID7, F, 48 years, ceased BP med)

3.3 Theme 3: Selective attention to interventions

The risk calculators showed the effects of single interventions on CVD risk. Those who were not taking medication often focused on side effects and the small risk reduction they would get compared to their probabilistic risk and lifestyle interventions.

"No wonder they're really reluctant to give you that stuff [statins]...Just because of those side effects. ...The physical activity is my preference and if that helps and my diet I’m happy to do that." (ID12, F, 57 years, no med)

In contrast, those on medication described medication as beneficial even when the risk reduction was very small, as confirmation that they were doing the right thing. This was the case even for participants who had expressed a preference to stop taking these medications.

"So taking the meds is good....By how much I wouldn't know unless I use an app like this but again it's bleeding obvious that if you do one thing it has a positive effect on one thing then it will have a flow on in the event of something else." (ID13, M, 62 years, med - diabetes)

"There's five of them, there's only four, doesn't matter, it's improvement, I would say, "Oh, that's good" (ID60, M, 64 years, med – chol and BP, est. CVD)

4. DISCUSSION AND CONCLUSION

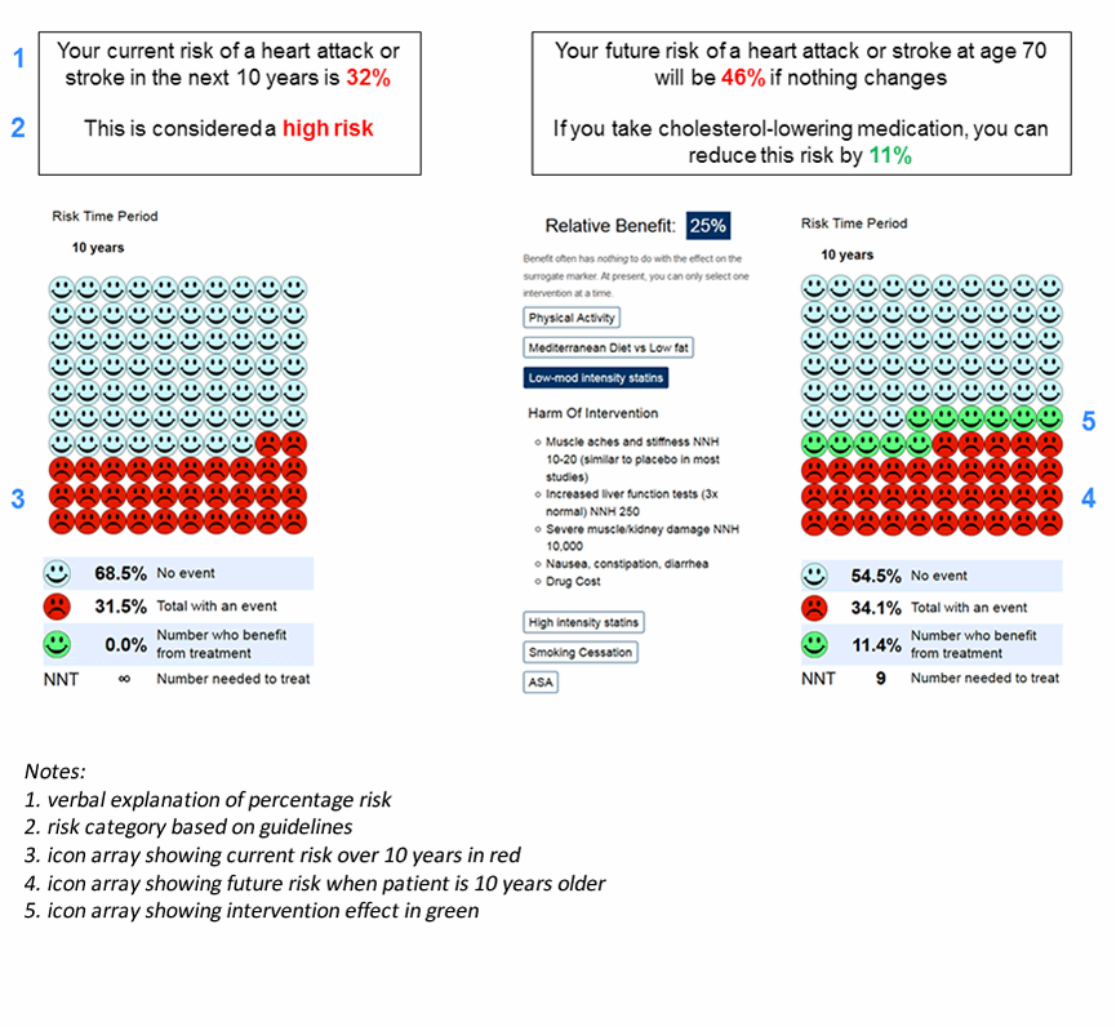
4.1 Discussion

We identified three key themes from showing participants their personalised CVD risk in various risk formats/timeframes. Firstly, numerical risk estimates were difficult to understand without a clear reference point (i.e. risk is 'high' or 'low'). Secondly, current risk needed to match expectations to be credible, but future risk was seen as novel and motivating. Thirdly, there appeared to be selective attention to interventions in a way that reinforced current medication adherence or avoidance.

Our findings suggest CVD risk calculators should include a variety of formats in order to meet the expectations of different patients. Drawing on a theoretical framework, we propose that different risk formats could overcome heuristics that may bias decision making. These are summarised in Table 3, and illustrated with examples in Figure 3.

Table 3: Relationship between risk concepts, risk formats and heuristics/biases

Risk concept	Useful risk formats	Key heuristics and biases
Binary possibility (risk does or does not exist)	Icon array: frowning red faces/smiling faces showing that CVD event may happen	Availability: negative emotional response to red frowning faces
Categorical possibility (verbal label for level of risk)	Risk category: low, moderate, high	Representativeness: Cognitive dissonance re unmet expectations about what own risk / high risk should look like
Probabilistic probability (numerical risk)	Percentage: verbal description of numerical result (e.g. 32% chance of CVD over 10 years)	Anchoring and adjustment: Base rate neglect with little attention paid to timeframe = longer timeframes with higher numbers more likely to meet expectations
Comparative probability (numerical risk compared to another risk)	Current risk vs future risk at an older age if nothing changes (e.g. 32% vs 46% over 10 years)	Anchoring and adjustment: comparing future risk to current risk increases impact of future risk
Incremental probability (numerical change in risk)	Icon array: Effect of intervention shown as green smiling faces (e.g. 11% less likely to have CVD event over 10 years)	Availability: positive emotional response to green smiling faces, and focus on either benefits OR harms based on medication views



Notes:
1. verbal explanation of percentage risk
2. risk category based on guidelines
3. icon array showing current risk over 10 years in red
4. icon array showing future risk when patient is 10 years older
5. icon array showing intervention effect in green

Figure 3: Most meaningful risk formats

These formats cover five distinct risk concepts according to Zikmund-Fisher's taxonomy: *binary possibility* (icon array indicating that a CVD event may or may not happen with frowning/smiling faces), *categorical possibility* (verbal risk category indicating low, moderate or high possibility of a CVD event), *probabilistic probability* (percentage chance of a CVD event occurring), *comparative probability* (comparing current risk to future risk in terms of CVD events), and *incremental probability* (the effect of an intervention on reducing CVD events) [27]. Bar graphs comparing current risk to average risk or target risk (with ideal risk

factors) did not resonate as well as icon arrays showing future risk with participants in this study.

The importance of providing appropriate context for risk is supported by the vast literature on cognitive heuristics and biases [20, 21]. For availability, participants appeared to engage with the salient faces in the icon array, with more negative emotional responses to red frowning faces and positive responses to green smiling faces. They also demonstrated a bias towards either benefits or harms of interventions depending on their medication views, and had difficulty imagining how evidence-based intervention effects related to their specific personal lifestyle. For representativeness, participants questioned the credibility of the calculator if the result was incompatible with prior perceived risk and what 'high risk' should look like, and ignored information that was inconsistent with their current status as someone on medication (suggesting high risk) or off medication (suggesting low risk). For anchoring and adjustment, participants used current risk to judge future risk, and used the first 5-year risk result to judge the second 10-year risk result. They also showed a form of 'base rate neglect' by ignoring the timeframe for the risk result until it was pointed out. Table 3 shows how these heuristics and biases relate to key risk formats and concepts in this study.

These heuristics and biases could be used to make the CVD risk concept more meaningful to individual patients. Explaining how additional risk factors relate to the risk calculation may ensure credibility and address cognitive dissonance when the result doesn't match expectations (e.g. weight is not included in the risk calculation because its effect on CVD risk is accounted for by blood pressure and cholesterol). Expectations about what 'high risk'

should look like can be addressed by using longer timeframes, and making use of anchoring effects by comparing current and future risk. Incremental probability to show the benefits of medication and lifestyle change may be more effective when the availability heuristic is invoked through use of affective risk formats (e.g. using symbolic colour and emotion through red frowning faces to convey risk). More direct comparisons of the effect of medication versus lifestyle changes (both benefits and harms) may be needed to overcome selective attention to incremental probability. Risk communication could also make better use of the availability heuristic, by framing interventions in a way that immediately relate to the patient's own lifestyle (e.g. walk 1 extra hour/week, cut 1 dairy serve/day).

These findings are compatible with previous research on the meaning of risk in CVD and other health areas. In CVD, previous studies have found more engagement and emotional reactions to salient risk formats such as heart age [28, 29], but this may be counteracted by questioning risk results that don't match expectations [11, 30]. Subjective perceptions of the need for medication may be focused on treating individual risk factors [31] and do not necessarily match actual estimates of CVD event reduction. The effect of age is also important to convey, since older age is the biggest predictor of under-estimating your own CVD risk [32]. Similar findings have also been demonstrated in cancer, where the clinical definition of 'high risk' does not necessarily match subjective perceptions [33], and specific risk formats can make people more or less receptive to medication [34, 35]. Providing a specific risk label (e.g. very common/rare) alongside risk has been found to enhance patient understanding of medication effects [36].

These qualitative findings could be complemented with quantitative testing of the suggested formats to test whether they improve patients' understanding of their CVD risk. The sample only included people who agreed to participate in a study on CVD risk, who may be more aware of their own risk compared to a new patient encountering their first risk assessment. The findings may also be different if a doctor was taking patients through this information.

4.2 Conclusion

The findings of this study suggest that probabilistic CVD risk may be more meaningful to patients when shown over a longer timeframe (10-year versus 5-year risk) with a verbal risk category (e.g. low or high), comparison to future risk using an icon array format, and the effect of interventions relevant to the patient. GPs need multiple, tailored formats for probabilistic CVD risk that can be adapted to suit the information needs of the patient.

4.3 Practice implications

For clinical practice, inconsistencies between international guidelines in terms of timeframes, risk factors and outcomes need to be clearly explained, to avoid confusion amongst GPs and patients about the meaning of a specific probability [1]. The influence of the chosen timeframe on risk perception should also be considered when developing guidelines and associated communication tools: choosing 5-year, 10-year or lifetime risk estimates can impact perceived risk. Ideally, thresholds for defining low versus high risk need to match patient expectations, which could potentially be addressed by a tailored approach based on manipulating the timeframe: those who view 10% as a high risk could receive a short timeframe, while those who view 50% as a high risk might need a longer

timeframe to convey the need for action. However, the timeframe would need to be clearly highlighted and explained to address base rate neglect and ensure patients make an informed choice. Future research could investigate optimal ways to present risk information in a way that 'debiases' our decision making through greater awareness of heuristics [37].

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Authorship contributions

All authors have materially participated in this research and/or article preparation. CB was responsible for the study conception, and contributed to study design, development of study materials, data collection, analysis, interpretation, drafting and revising the manuscript. SM contributed to the development of study materials, data collection, analysis, interpretation, and revising the manuscript. AL contributed to the development of study materials, analysis, and revising the manuscript. JJ contributed to study design, development of study materials, interpretation, and revising the manuscript. JD contributed to study design, development of study materials, interpretation, and revising the manuscript. LT contributed to interpretation and revising the manuscript. KM contributed to study design, development of study materials, interpretation, and revising the manuscript. All authors read and approved the final manuscript.

Conflicts of interest

The University of New South Wales and Annie Lau could benefit from the commercial exploitation of the Healthy.me platform or its technologies. The other authors have no conflicts of interest to declare.

Ethical approval and participant consent

Ethical approval for the study was obtained through the Human Research Ethics Committee of the Sydney Local Health District (Protocol No. X11-0200). Each participant gave written consent before participating in the interview. I confirm all patient/personal identifiers have been removed or disguised so the patient/person(s) described are not identifiable and cannot be identified through the details of the story.

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